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UTILITY PATENT APPLICATION TRANSMITTAL
(Small Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
36457.0200

Total Pages in this Submission

C921 U.S. PTO 09/710488 11/10/00

TO THE ASSISTANT COMMISSIONER FOR PATENTS
Box Patent Application
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

METHOD AND SYSTEM FOR ENGINEERING AND BUSINESS ASSESSMENT AND SOLUTIONS

and invented by:

Robert P. Wong, et al.

If a CONTINUATION APPLICATION, *check appropriate box and supply the requisite information:*

☐ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: _____

Which is a:

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Enclosed are:

Application Elements

1. ☒ Filing fee as calculated and transmitted as described below

2. ☒ Specification having 37 pages and including the following:

   a. ☒ Descriptive Title of the Invention

   b. ☒ Cross References to Related Applications *(if applicable)*

   c. ☐ Statement Regarding Federally-sponsored Research/Development *(if applicable)*

   d. ☐ Reference to Microfiche Appendix *(if applicable)*

   e. ☒ Background of the Invention

   f. ☒ Brief Summary of the Invention

   g. ☒ Brief Description of the Drawings *(if drawings filed)*

   h. ☒ Detailed Description

   i. ☒ Claim(s) as Classified Below

   j. ☒ Abstract of the Disclosure

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Application Elements (Continued)

3. ☒ Drawing(s) *(when necessary as prescribed by 35 USC 113)*
   a. ☐ Formal b. ☒ Informal Number of Sheets 9

4. ☒ Oath or Declaration
   a. ☐ Newly executed *(original or copy)* ☒ Unexecuted
   b. ☐ Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional application only)*
   c. ☐ With Power of Attorney ☒ Without Power of Attorney
   d. ☐ *DELETION OF INVENTOR(S)*
   Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. 1.63(d)(2) and 1.33(b).

5. ☐ Incorporation By Reference *(usable if Box 4b is checked)*
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Computer Program in Microfiche

7. ☐ Genetic Sequence Submission *(if applicable, all must be included)*
   a. ☐ Paper Copy
   b. ☐ Computer Readable Copy
   c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. ☐ Assignment Papers *(cover sheet & documents)*

9. ☐ 37 CFR 3.73(b) Statement *(when there is an assignee)*

10. ☐ English Translation Document *(if applicable)*

11. ☐ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations

12. ☐ Preliminary Amendment

13. ☒ Acknowledgment postcard

14. ☐ Certificate of Mailing
   ☐ First Class ☒ Express Mail *(Specify Label No.):* EL426885146US

UTILITY PATENT APPLICATION TRANSMITTAL (Small Entity) *(Only for new nonprovisional applications under 37 CFR 1.53(b))*	Docket No. 36457.0200
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Accompanying Application Parts (Continued)

15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

16. ☐ Small Entity Statement(s) - Specify Number of Statements Submitted: _____

17. ☐ Additional Enclosures *(please identify below):*

Request That Application Not Be Published Pursuant To 35 U.S.C. 122(b)(2)

18. ☐ Pursuant to 35 U.S.C. 122(b)(2), Applicant hereby requests that this patent application not be published pursuant to 35 U.S.C. 122(b)(1). Applicant hereby certifies that the invention disclosed in this application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication of applications 18 months after filing of the application.

Warning

An applicant who makes a request not to publish, but who subsequently files in a foreign country or under a multilateral international agreement specified in 35 U.S.C. 122(b)(2)(B)(i), must notify the Director of such filing not later than 45 days after the date of the filing of such foreign or international application. A failure of the applicant to provide such notice within the prescribed period shall result in the application being regarded as abandoned, unless it is shown to the satisfaction of the Director that the delay in submitting the notice was unintentional.

UTILITY PATENT APPLICATION TRANSMITTAL
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Fee Calculation and Transmittal

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	15	- 20 =	0	x $9.00	$0.00
Indep. Claims	3	- 3 =	0	x $40.00	$0.00
Multiple Dependent Claims (check if applicable) ☐					$0.00
				BASIC FEE	$355.00
OTHER FEE *(specify purpose)* _____					$0.00
				TOTAL FILING FEE	$355.00

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- ☐ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Dated: **November 10, 2000**

R Lee Fraley

Signature

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METHOD AND SYSTEM FOR ENGINEERING AND BUSINESS ASSESSMENT AND SOLUTIONS

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FIELD OF THE INVENTION

The present invention relates to a method and system for providing assessment and solutions to engineering and business problems. More particularly, the present invention relates to a method and a system for facilitating solutions for engineering and business problems through automation of information identification, assessment and analysis of the problems.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority of prior-pending U.S. Provisional Patent Application No. 60/165,115, filed November 12, 1999, and entitled, METHOD AND SYSTEM FOR WORKPLACE JOB ASSESSMENT, which is hereby incorporated by reference herein.

BACKGROUND OF THE INVENTION

The available resources for solving various industrial, manufacturing , engineering or business problems are often limited by the few products and services available to efficiently, accurately, and cost-effectively monitor, analyze, and solve those problems. In most instances, the knowledge for resolving these problems is readily available, however, access to this knowledge is limited. For example, the availability of problem solving functions are often

limited by the lack of available human capital to perform the in-depth analysis necessary to resolve such problems. In addition, the problems associated with industrial, manufacturing, engineering and business operations are often complex. For many types of complex problems more than one solution to the problem exist due to the complex relationship among the variables, factors and elements of the problem. Thus, complex problem solving often requires even more resources than more simple problems, such as those occurring around the common household.

In resolving the various business problems, generally a first step comprises identification of a "problem" or "issue", which comprises a question or inquiry proposed for solution, decision or determination, such as any industrial, manufacturing, engineering or business problem or issue that one desires to resolve. For example, problems could include the need to increase the productivity on a manufacturing line, the need to conduct a valuation of facilities or property prior to sale or acquisition of the facilities or property, or the need to reduce the ergonomic, safety and health risks and injuries in the workplace.

Upon identification of a problem, information relating to, or defining, the problem generally needs to be collected to facilitate analysis and assessment of the information. This information is typically collected by the company at the request of various engineering or business consultants and experts, or collected directly by those consultants or experts. This information can include a wide variety of data, statistics, measurements and other like information relating to the problem to be assessed or analyzed. Further, the level of detail of the information can comprise various levels, such as low level information, for example, the number of devices to be manufactured, the number of hours of an employee on the job, or the number of rooms in a building, or high level information, such as the particular number of manufacturing delays resulting from operator error, the average price per square foot of like-sized building in

the area, or the frequency and duration of particular arm movements of an employee within a given work shift.

Having collected and obtained various types and amounts of information relating to a problem, an analysis and assessment of the information can be conducted by the various engineering and business consultants, experts and the like who have developed a knowledge base relevant to the given problem or issue. Based on that knowledge base, various levels of analysis and assessment can be provided, such as a generalized analysis and assessment or a very detailed analysis and assessment which produces specific suggestions and recommendations tailored to addressing specific risks or factors, as well as the ability to predict costs and performance results from enacting the recommendations.

However, facilitating this issue identification, information collecting and assessment process can be a problem for many companies. For example, while many companies may have some internal staffing and the internal resources to learn the requisite knowledge to resolve many of these problems and issues internally, this learning process generally takes too much time. Companies may also attempt to develop their own knowledge base for resolving the problems and issues, however, these efforts often result in "re-inventing the wheel" in which the resulting development costs and time for development are greater than the option of hiring a consultant or expert. While obtaining the assistance of consultants and experts can reduce this time period, the associated costs in bringing a staff or group of consultants to collect information and analyze and assess the issues at the companies operations can be still be quite costly, and the availability of these consultants and experts is often less than the number of problems and issues needing resolved.

One area where the need to resolve engineering issues is increasing is in the field of ergonomics. Corporations are currently spending over $60 billion annually for compensable injuries in every type of work environment. Ergonomics awareness is increasing with rising illness and injury trends, an aging work force, more women in the work environment and large percentages of the work force being affected by cumulative trauma disorders (CTD) type injuries. These CTD type injuries are typically due to inadequately designed workstations, processes, equipment and tools. When designing a manufacturing process, very little attention is often paid to the workers' accommodation and environment based on the job requirements. This lack of job design knowledge is displayed in the injury/illness rates for workers' compensation claims, lost work time, quality issues and product liability claims.

The labor force in the U.S. is projected to increase by 15 million over the 1996-2006 period, from 134 million to 149 million, an increase of 11%. In addition to a growing workforce, the injury rates could increase over the next five years due to an aging working population and the addition of more women entering the workforce as both groups can often be more susceptible to injury and lost work time in the work environment. As an example of the need for ergonomic intervention when designing jobs, tools, workstations and equipment, it is expected that 48% of the employees in the US by the year 2005 will be women. (Bureau of Labor Statistics, 1995). Further, it is expected that the U.S. labor force age group 45-64 years of age will grow faster than the labor force of any other age group as the baby-boom generation continues to age. As a result, the increase in the average age of the working population and the number of women entering the workforce precipitates the need for ergonomic engineering related services in many countries, including Japan. These expected problems reflect the need for ergonomic engineering services and products to assist global companies in reducing costs.

In addition, ergonomics is also receiving renewed attention in the workplace as companies and government realize its impact on productivity and worker safety and health. For example, on February 19, 1999, the Occupational Safety and Health Administration (OSHA) announced the publishing of a draft ergonomic standard that requires companies to perform an ergonomic workplace analysis after the occurrence of even a single cumulative trauma injury. Further, many companies have started their own ergonomic initiatives independent of government regulations to realize the cost savings and productivity gains associated with a health workforce.

As a result of the foregoing, the total market for ergonomic services and analysis products is expected to grow rapidly fueled by the growth in ergonomic awareness, government regulations, and gains in productivity realized from the reduction in workplace injuries. Unfortunately, there are few products and services available to efficiently, accurately, and cost-effectively monitor, analyze, and solve problems relating to the workplace and resulting products. Moreover, since these cumulative trauma disorder (CTD) type injuries are not single event oriented, the simple monitoring of such past events can not provide a very effective means for reducing and preventing these type of injuries.

Accordingly, a need exists for an improved method and system for assessing and resolving various engineering and business solutions that overcomes the problems described above. In addition, a need exist for a method and system to reduce and prevent not only single event-type accidents and injuries in the workplace, but also these cumulative trauma disorder (CTD) type injuries.

SUMMARY OF THE INVENTION

A method and system according to the present invention addresses many of the shortcomings of the prior art. In accordance with one aspect of the invention, a system for facilitating resolution of engineering and business issues is provided comprising an issue component for identifying the issues to be resolved, an inquiry component for facilitating collection of client information relevant to the issue component to facilitate definition of the issue component, a knowledge base comprising data and information for facilitating assessment of the client information; and a solution base for compiling assessments and recommendations from the knowledge base and for reporting the assessments and recommendations to a client. In addition, the system can include a network for communicating the client information to the knowledge base and for communicating the assessments and recommendations to the client.

In accordance with another aspect of the invention, the knowledge base comprises an artificial intelligence engine for assessing the client information, wherein the artificial intelligence engine is configured for comparing the new issue with an existing issue within a database to determine if similar, and thus provide a recommendation associated with the existing issue, and for breaking down the new issue into smaller components for further comparison if the existing issue is not similar to the new issue to thus provide a suggestion associated with said smaller components. As a result, an optimal set of suggestions and recommendations can be provided for a given engineering or business issue or problem. In addition, in accordance with another aspect of the present invention, the above method can be further broken down into smaller elements and sub-elements to provide a more detailed analysis.

In accordance with an exemplary embodiment, the above system and method can be suitably utilized to resolve various ergonomic engineering issues. In accordance with this

embodiment, a method for reducing ergonomic injuries in the workplace comprising the steps of identifying an ergonomic issue occurring at a client operation, collecting information relevant to the ergonomic issue, assessing the information collected to provide recommendations for resolving the ergonomic issue, and providing the recommendations to a client, wherein the step of assessing comprises using an artificial intelligence engine, such as the artificial engine described above to provide the recommendations.

BRIEF DESCRIPTION OF THE DRAWING

A more complete understanding of the present invention may be derived by referring to the detailed description when considered in connection with the figures, where:

Figure 1 is a block diagram representation of an exemplary system for problem assessment in accordance with the present invention;

Figure 2 is a block diagram representation of an exemplary method for problem assessment in accordance with the present invention;

Figure 3 is a block diagram of an exemplary method for obtaining solutions to a problem in accordance with the present invention;

Figure 4 is an exemplary embodiment of a table of technical actions in accordance with an exemplary embodiment of the present invention;

Figure 5 is a block diagram of an exemplary embodiment of a information identification process in accordance with the present invention;

Figure 6 is a block diagram of an exemplary embodiment of an exertion scale in accordance with the present invention;

Figure 7 is an exemplary embodiment of a graphical display for facilitating the collection of information in accordance with the present invention;

Figures 8A and 8B are illustrations of exemplary displays for facilitating collection of information;

Figure 9 is a block diagram of an exemplary embodiment for problem solving in accordance with the present invention; and

Figure 10 is an exemplary embodiment of a system for practicing the method in accordance with the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT

The present invention may be described herein in terms of various software modules and processing steps. It should be appreciated that such modules and steps may be realized by any number of hardware components configured to perform the specified functions. For example, the present invention may employ various input/output devices, data storage and memory devices, buffers, terminals, and the like, which may carry out a variety of functions under the control of one or more microprocessors or other control devices. In addition, those skilled in the art will appreciate that the present invention may be practiced in any number of engineering and business contexts and that the exemplary embodiment relating to ergonomics in the workplace as described herein is merely one exemplary application for the invention. For example, the principles, features and methods discussed may be applied to any general health and safety application within a workplace. Further, various aspects of the present invention may be suitably applied to other industrial, manufacturing or engineering problem solving applications.

As discussed above, the available resources for solving various industrial, manufacturing or engineering problems and issues are often limited by the few products and services available to efficiently, accurately, and cost-effectively monitor, analyze, and solve those problems, including the limited access to various consultants and experts and thus to their inherent knowledge base. However, to address the need for improved problem assessment and solving techniques, a method and system has been developed in accordance with the present invention which overcomes the limitations described above.

With reference to Figure 1, in accordance with the present invention, an exemplary method and system 100 for facilitating resolution of engineering and business problems and issues is illustrated. System 100 comprises an issue component 102, an inquiry component 104, a knowledge base 106 and a solution base 108. Issue component 102 comprises the statement of a problem or issue. Issue component 102 can comprise any problem or issue providing a question proposed for solution, decision or determination, such as any industrial, manufacturing, engineering or business problem or issue that one desires to resolve. Inquiry component 104 comprises the inquiry made by a company to access knowledge base 106, such as an inquiry from the company to a consultant or expert, or from the consultant to the company, to identify the issue or problem and thus collect relevant information to further define the problem as well as facilitate a solution 108. Thus, a function of inquiry component 104 is to facilitate the extraction of information from the company to facilitate analysis and assessment of that information and evaluation of knowledge base 106.

In addition, inquiry component 104 can be conducted in various manners, including, for example, direct questioning by consultants or experts, or the completion of questionnaires or other like methodologies for information collecting. This information can also be transmitted

112 from the company to the consultant or expert in various manners, such as by direct discussion, by written correspondence, or by way of network communications, such as through an IP network.

Once the information is collected through inquiry component 104, the information can be suitably assessed and evaluated through use of knowledge base 106. Knowledge base 106 suitably comprises the wealth of information, data, knowledge and the like that facilitates the development of solutions 108 corresponding to the various issues and problems 102. Knowledge base 106 comprises an ongoing compilation of information as provided by various consultants and experts, such as previous personal experiences, by referral to specific files and case databases, or through the analysis and results of prior cases for resolving problems and issues. In addition, the knowledge base 106 is adaptable, such as by the continuing interrogation of information and assessment of cases. Thus, from the information collected in inquiry component 104, and the information contained in knowledge base 106, an assessment can be conducted to provide one or more solutions 108.

The assessment process comprises the determination of the rate or amount of a component within the collection of facts, such as the level of risk, or rate of productivity. In addition, the assessment process comprises the examination of a complex problem, its related elements and their relationship together or with other problems and elements. The assessment process can be conducted in various manners, for example, by manual review and analysis by engineers, technicians or managers and the like through use of knowledge base 106. In addition, the assessment process can be facilitated by the use of automated devices, including computers and microprocessors and the like. Further, such automated features can be facilitated by the use

of various artificial intelligence (AI) techniques to provide a high-level, mid-level or detailed assessment of the problem.

Upon assessment and analysis of the information collected from inquiry component 104 and knowledge base 106, various recommendations and solutions in solution base 108 can be provided to the company or requester by way of transmission 110. Solution base 108 can comprise various levels of recommendations, such as general recommendations, prioritization recommendations, or specific recommendations, including various sets of suggestions. In addition, solution base 108 can be transmitted 110 by various methods, such as by direct verbal communication or written communication by way of telecommunications or mailing correspondence, or by way of network communications, such as through an IP network.

One such area where the above invention is very suitable is within the ergonomic engineering industry. As discussed above, the demand for ergonomic assessments is increasing ever-rapidly. However, with respect to most companies, there is a lack of basic understanding of general ergonomic principles to facilitate resolution of many of their ergonomic problems and issues. While many of these issues can be readily resolved by current knowledge bases, access to that knowledge is most often limited. In addition, many ergonomic issues that arise in industry may not be able to be suitably resolved through use of present day knowledge bases. For example, most knowledge bases have been developed for working groups comprising mainly middle-aged men; as a result of the increase of older working groups and women entering the workforce, these knowledge bases may prove to be insufficient. Moreover, the time to update and improve these existing knowledge bases is short, due to the immediate need for more reliable information.

Thus, to facilitate a more detailed discussion of various aspects of the present invention, an exemplary embodiment of a method as applied to an ergonomic application for reducing ergonomic related injuries in the workplace will be described in accordance with the present invention. With reference to Figure 2, an exemplary method 200 comprises a problem identification step 202 and an assessment step 203. While various methodologies can be utilized for step 202, in accordance with the exemplary embodiment, the PLIBEL methodology, for example as referenced in "A Method Assigned for the Identification of Ergonomic Hazards", Kristina Kemmlert, National Institute of Occupational Health, can be suitably incorporated.

In identification step 202, the collection of data and information relating to the problem or problems within a particular case is conducted. This collection of information can be facilitated by a checklist of questions configured for identifying the problem and addressing the most prevailing hazards and risks typically dominant in the workplace. For example, the checklist can be designed to test an industrial job for various typical ergonomic hazards. The questions available from such a checklist can relate to workspace, movement and effort to determine high-level risks that may be encountered in the workplace, such as questions directed to the effect or impact on the neck, shoulders, elbows, forearms, hands, feet, knees, hips and lower back. For example, the questions could inquire into whether any tools or equipment are unsuitably designed for the worker or for the task, whether the working height of workspace elements, such as tables, desks or chairs, are adjusted properly, and whether fatiguing foot-pedal or hand-lever operating work is performed. Other like high-level questions obvious to one skilled in the art can also be included within identification step 202. In addition, the questions can be configured for single answers, or for multi-part answers. Moreover, the collection of

information is not limited to a checklist, but instead can comprise any method or system for collecting or identifying information and data relating to a problem or set of problems.

Upon completion of identification step 202, assessment step 203 can be suitably provided. In this regard, step 203 can comprise a simple recap of the information collected in step 202 and can provide a series of high-level recommendations to the end user, such as may be available from a database of cases of previously analyzed problems. In addition, the recommendations can be facilitated by an artificial intelligence (AI) search engine. Further, in accordance with an exemplary embodiment for assessment step 203, the various ergonomic risks can be suitably identified for each defined body area identified in step 202 and listed or displayed for the system end user.

As discussed, these high-level recommendations can be provided from an artificial intelligence (AI) search engine. In accordance with an exemplary embodiment, a rules-based AI engine is suitably incorporated. The rule-based AI engine comprises a deterministic approach which provides an algorithm based on a series of chained rules that suitably define a solution based on the questions answered in step 202. Thus, as various of the responses to the questions are identified, the series of chain rules can be suitably applied to provide high-level recommendations. These recommendations can relate to various categories of solutions, for example, product recommendations, administrative recommendations, and engineering recommendations. While these recommendations may not be the optimal solutions to a given problem, these recommendations comprise appropriate solutions based on the amount and type of information collected in step 202. As a result, the end user can quickly and efficiently obtain plausible solutions to a given problem.

In the event that the end user requires a greater level of solution to a given problem, or a more optimized or quantified solution, for example, in accordance with another exemplary embodiment, method 200 comprises an identification step 202, a prioritization step 204 and an assessment 205. In accordance with this embodiment, a more detailed prioritization of ergonomic risks that can result in injury in the industrial workplace is provided. This more detailed prioritization can be realized, for example, by the examination of zones of motion for the employee, as well as the force and effort exerted during these motions, to provide an assessment of the danger level that is indicative of changes needed in the ergonomic program. This assessment of the danger level can comprise a numerical ranking of the severity of the ergonomic risks on the individual.

Continuing in accordance with this embodiment, identification step 202 comprises a more detailed collection of information than provided under the high level assessment described above. Thus, in addition to the high-level information, identification step 202 can suitably request detailed measurements to be taken for the individual and the surrounding ergonomic environment. For example, detailed information surrounding the zone of motion for the arms, wrists, neck, trunk and legs can be collected.

To facilitate the collection of such detailed information, identification step 202 can include graphical displays that represent various movement ranges. For example, with reference to Figure 7, an exemplary graphical display for various upper arm movements is illustrated. Through use of a display configured for a particular body part, such as the arms, wrists or legs, the end user can suitably select a displayed range of motion which best represents the end user's work environment. Such an inquiry into the selection of a suitable range of motion can be

conducted for various of the body areas, and for each side of the body. In addition, preliminary information regarding the force and exertion can also be collected for the various body areas.

In accordance with another exemplary embodiment, an optional section inquiring into lower back problems can also be suitably included. For example, if an individual is involved in lifting activities in the workplace, the end user can be presented with graphical displays depicting the type of lift, including an inquiry into the weight of the item and the distance from the body of the item being lifted.

Upon completing the more detailed identification step 202, a prioritization step 204 is suitably configured to provide a broad scale measurement of the likely exposure to various ergonomic risks and provide likely outcomes from various suggested actions to be offered in assessment 205. To facilitate the broad scale measurement and assessment, prioritization step 204 suitably includes the use of mathematical calculations. In accordance with this aspect of the present invention, for each response to the inquiries of range of motion for various body parts, a corresponding point value is suitably assigned. In addition, these corresponding point values can also be suitably scaled and/or adjusted by information collected regarding force and exertion data for those body parts. After obtaining the corresponding adjusted values for the given body parts, including both sides of the body, the values can be suitably compared to determine the potential exposure levels. For example, the values can be suitably plotted in a matrix configuration to provide an exposure index value or rating. These corresponding adjusted values can also be evaluated by other known methodologies, such as regression analysis and the like, to provide a exposure rating that corresponds to an appropriate action level suitable for recommendation to the end user in assessment 205.

In addition to the mathematical calculations above, the more detailed collected information can also be suitably provided to an AI engine, such as the rule-based AI engine described above. Thus, as various of the responses to the questions are identified, the series of chain rules can be suitably applied to provide mid-level recommendations, such as, for example, product recommendations, administrative recommendations, and engineering recommendations in assessment 205. While these recommendations may not be the optimal solutions to a given problem, these recommendations comprise more detailed solutions based on the amount of additional detailed information collected in step 202. As a result, the end user can quickly and efficiently obtain plausible solutions to a given problem.

In the event that the end user requires an even greater level of solution to a given problem, for example, a more optimized problem, in accordance with another exemplary embodiment, method 200 comprises an identification step 202 and a detailed risk assessment and solution step 206. In accordance with this exemplary embodiment, a more detailed and concise assessment of ergonomic risks and impacts that can result in injury in the industrial workplace is provided. In addition to the information and assessments obtained above, this exemplary embodiment provides a more concise index for determination of ergonomic stress in the various body parts resulting from repetitive motion over time. In addition, an analysis can be suitably conducted based on a comparison between the actual amount of work performed during an employee's work shift and a recommended amount of work to be done for the same work shift. Although various methodologies for making such a comparison can be utilized, as well as various methodologies for the assessment of exposure to repetitive movements of various body parts, a OCRA methodology is preferably utilized. Further, while various AI engine methodologies can be utilized, in accordance with a preferred embodiment, an improved

artificial intelligence engine is implemented to analyze the detailed data and provide recommended solutions.

Continuing in accordance with the present exemplary embodiment, identification step 202 suitably comprises a collection process for obtaining more concise and detailed information in addition to the information described above. For example, for a given ergonomic case, that case can be broken down into a plurality of problems, with each problems being capable of being broken down further into various other levels of components and elements. With reference to Figure 5, an exemplary embodiment of such a concise identification step 202 is illustrated which includes a plurality of information collecting and identification steps. In accordance with this embodiment, identification step 202 comprises a task identification and definition step 502, a task scheduling step 504, a define technical actions step 506, a perceived exertion step 508, and an analysis of technical actions step 510. However, other embodiments can comprise fewer than these five steps, others can comprise various order combinations of these steps 502 through 510, and other embodiments can comprise additional steps requesting or inquiring into information as described herein.

Task identification and definition step 502 suitably comprises the identification and definition of the basic tasks that comprise a particular job. For example, the end user may provide the identification of the task, such as by providing a task name or identifier. In addition, information indicating whether or not the task is repetitive or non-repetitive, and for repetitive tasks, the duration of an individual cycle, for example, the minimum, average and maximum duration of the repetitive cycle, can be suitably identified. Accordingly, a menu of the various tasks indicative of the repetitive characteristics can be compiled for further use, analysis and assessment.

Task scheduling step 504 suitably comprises the implementing of the tasks into a time framework over the course of the workday. For example, the end user can utilize the menu of tasks from step 502 to suitably build a table indicative of how that end user's time is distributed among the various tasks. The table can comprise a scheduled time block, for example in fifteen, half-hour, or one-our increments. The end user can suitably include the task names within the appropriate time blocks as those tasks are performed during the work day to indicate the order and the duration of those tasks. In addition, for repetitive tasks, the number of cycles, or frequency of cycles, can be suitably indicated.

Define technical actions step 506 suitably comprises the further breaking down of the various repetitive tasks, to the extent any exist, into various technical actions. For example, the end user can break the repetitive tasks down to technical actions comprising lists of "thiarbliags", i.e., verbs that make up a technical action, such as lift, bend, raise and the like, and associated items being acted upon, e.g., boxes, crates, levers, switches, tools and the like. In addition, the end user can indicate the number of repetitions for each technical action, as well as whether the action is conducted on the right or left side of the body, or on both sides of the body.

With reference to Figure 4, an exemplary detailed table as may be derived from definition of technical action step 506 is illustrated. In this example, a repetitive task R-1 such as "cutting of large shells" is suitably identified, and is comprised of various technical actions, such as "place shell on the lathe" and "lower lever" actions among others. In addition, the number of repetitions and the indication of whether the repetitive action occurs on the right side or left side of the employee's body is indicated. In addition, task R-2 and various other tasks as requested can also include detailed information as to technical actions, repetitive cycles and body side location to facilitate further assessment.

Perceived exertion step 508 suitably comprises the definition by the end user of the levels of perceived exertion that are associated with each of the technical actions identified in step 506. Such definition of levels can comprise subjective analysis, and can include the rating of the level of perceived exertion by the end user and the assigning of a numerical value to that perceived level. In accordance with a preferred exemplary embodiment, a Borg's scale value system can be utilized, for example the scale illustrated in Figure 6 which has a range of exertions ranging from a rating of NOTHING AT ALL to a rating of VERY, VERY STRONG (ALMOST MAXIMUM) over a numerical range of 0 to 10. Thus, in this example, if a perceived exertion level is SOMEWHAT STRONG, a value of 4 can be assigned; if a perceived level is determined to be VERY WEAK, a value of 1 can be assigned. However, it should be noted that step 508 is not limited to the scale illustrated in Figure 6. For example, various other subjective levels of perceived exertion can be included within the scale, while various of the levels illustrated in Figure 6 can also be deleted or removed. Further, any scaling system that provides a rating of minimum and maximum levels of perceived exertion can be utilized. In addition to the assessment of the perceived level of exertion, the duration of the exertion can be suitably indicated by the end user. This duration can be displayed in various manners, such as in units of minutes and/or seconds.

Analysis of technical actions step 510 suitably comprises the capture of the detailed movement and positioning data for each task identified in step 502. To facilitate the collection of this information, a survey inquiry can be made that features the job profile information, the task name and the various technical actions. Data and information can be collected that is associated with the various body parts analyzed, such as, for example, the arms, shoulders, wrists and fingers. For example, with reference to Figures 8A and 8B, each technical action is suitably

identified by body part and side, such as, for example, "Elbow Movements- Right Side." In this example, a display image demonstrating a range of motion can be suitably included to aid the end user in quantifying and/or identifying the range of motion for various body parts, such as supination, pronation and flexion or other ranges of motion, as well as the amount of time that such a range of motion occurs.

In addition to the above assessment of the detailed movement and positioning of the various body parts during the various tasks, in accordance with another embodiment, step 510 can also include a survey regarding activities impacting the lower back region of the body. In this embodiment, the lower back survey comprises a more complex information inquiry than that inquired in step 204, and can include, for example, the starting and ending height of a given lift, the angles of lifting, the positioning of the hands with respect to the given item to be lifted, and other like variables to derive an ideal lifting weight. Additionally, step 510 may comprise the collection and assessment of video data that may be suitably reviewed by consultants or analyzed through automation, such as by digitizing the videotape and mapping a dynamic three-dimensional computer mannequin or the like to the job location.

After obtaining the detailed information from identification step 202, such as provided in steps 502 through 510, a detailed assessment and solution step 206 can be suitably conducted to facilitate a more concise assessment and solution to the ergonomic problem. In step 206, the detailed information collected in step 202 is suitably analyzed to generate various levels of summaries, suggestions and recommendations. For example, a project summary can be provided which describes high-level data about the number of jobs analyzed and which jobs demand or should seek ergonomic attention. The jobs can be listed in the order of exposure, such as by an exposure index determined in step 204, i.e., the job with the most ergonomic risk can be

identified first and/or the jobs can be suitably classified into different risk categories based on exposure index values. The detailed information collected for each job task in step 202, such as task description, duration, frequency of repetitions/cycles, total actions and the like, as well as a graphical representation of the daily schedule can also be provided.

From the summary of data provided above, detailed assessments and recommendations can be provided. For example, the discussion of high-level information, such as that obtainable from assessment 203, can be provided along with assessment information regarding exposure levels, such as a detailed explanation of the exposure index found for each body part in assessment 205. Further detailed recommendations can also be provided. For example, to facilitate an understanding of the recommendations, a more detailed explanation of the differences between product recommendations, engineering recommendations and administrative recommendations can be provided.

In accordance with an exemplary embodiment, two sets of recommendations can be provided. The first set comprise more basic recommendations, such as the product recommendations available from assessment step 203. The second set comprises refined recommendations which include engineering and administrative recommendations. These recommendations can be suitably generated from the detailed information through the use of AI engines as described above, such as a rule-based AI engine. If, however, more refined or optimal recommendations are desired in addition to the high-level engineering and administrative recommendations, such as available from assessment step 203, an improved AI engine can be provided.

In accordance with an exemplary embodiment, to provide the more refined or optimal recommendations, step 206 suitably utilizes a case-based AI engine to provide suitable

recommendations. The case-based AI engine suitably comprises a case-based reasoning engine which is capable of finding previous cases that approximate or match various of the criteria and information from the currently examined case, and can make similar recommendations. In addition, the case-based engine can become a multi-level analysis by further breaking down the cases into a plurality of problems or components to conduct the matching process, or by breaking down further the problems or components into elements and sub-elements to provide further detailed matching between various elements of other cases. In accordance with another aspect, the case-based engine continues to grow more powerful and effective as the case base continues to grow. For example, as end users more and more frequently use the system and step 206, cases comprising new sets of problems, components and elements may be added to the case database, either in their entirety or selectively, to provide a continually improving AI engine, i.e., a incrementally improving AI engine. Such an adaptive AI engine can be particularly beneficial where the previous knowledge bases corresponded with issues and problems for a given set of demographics, e.g., middle-aged men working groups, and the need for an updated knowledge base is great, e.g., one for older-aged workers and for women. As a result, the AI engine comprises a heuristic process which can build solutions for an evolving set of cases and problems.

With reference to Figure 3, an exemplary method and system 300 for operation of a case-based AI engine is illustrated. In this example, information can be input to system 300 to develop a statement of the problem 302. The statement of the problem step 302 is suitably configured to genericize the input information received during identification and information collecting steps to facilitate the understanding, analysis and assessment by the AI engine. For example, step 302 may review the input information and find appropriately matching key words

which provide a generic term or phrase, or step 302 may simply offer the end user various choices of key words to select from when describing the case or problems.

After statement of the problem step 302, the AI system 300 is configured to assess a database of cases in a step 304. The database of cases comprises an ever-growing database of previous cases analyzed by the AI engine, or other engines, and can be configured to add all cases previous addressed or cases suitably selected by an administrator. In addition, for example during start-up of the AI engine, an administrator may "prime" the engine by providing previous cases, such as cases previously analyzed by AI engines, or cases previously resolved by manual operation and analysis. In any event, prior to adding a case, a database administrator can assess whether the case, including the combination of data collected and recommendations provided, should be added to the database. In this regard, the administrator can assess whether the case is redundant, too specialized or otherwise not appropriate.

To assess the database of cases, step 304 can search for previous cases having nearly identical or similar matches within a margin of error. For example, a case having 98% correlation or higher, or for lower level matches, such as greater than 95% correlation between the current data and a previous case or cases can be selected. If a matching correlation is determined, i.e., the current case and a database case relate essentially one to one within the margin of error, the previous solution from the matched case can be provided in step 306, wherein the solution can be suitably reported. However, if no suitable case is identified, the margin of error can be suitably increased, such as to 85%, and then the matching process can be reconducted.

If, however, no current cases have an extremely high level of one-to-one correspondence, or the margin of error is not widened or increased, the AI engine can proceed to a step 308 to

restate the current problem. Here, the cases can be broken down into sets of problems, into further sets of components and into further sets of elements or sub-elements. For example, step 308 can be configured to suitably break the problem down into element by body part, or element by motion or activity, such as the level of detail collected in detailed identification step 202..

Thus, rather than the matching of a few key terms of a case, a detailed assessment can be conducted in step 310 as to the correlation of various sets of problems, components, elements, functions and activities to find the problems or elements with the highest one-to-one correspondence. For example, step 310 may find a first case that correlates at 70% overall with respect to the current case, but has a first component which correlates highly with respect to upper arm movement set forth in the current case, and a second case that correlates at 60% overall with respect to the current case, but has a second component that correlates highly with respect to repetition and cycles components set forth in the current case. Accordingly, while neither the first case or the second case does not have desirable level of one-to-one match, the combination of the two components can yield a new case having a higher correlation, for example, one having greater than 80%. Thus, step 310 can extract solutions and recommendations from parts of the first and second cases to provide an improved solution in step 306.

In addition, step 310 can derive solutions through other empirical methods, for example, by filing in missing components of information, or deleting or ignoring various pieces of information, if the information does not correlate with previously identified cases having similar features and elements. Further, as a method for verifying the learning process of the AI engine, feedback can be provided by ergonomic consultants and experts as to the recommended solutions

in 306, as well as performance or results feedback in the event the end user implements the solutions.

In addition to the product, engineering and administrative recommendations, the prioritization of risks and the summary of information collected, step 206 can also be configured to provide injury cost projections which can calculate and report projected cost savings if various of the recommendations are implemented. The costs projections can be developed through use of exposure rating calculations, such as an exposure index. The cost projections can also include the costs associated with missed work, workman's compensation, and medical and insurance expenses.

Still further, step 206 can also include further information regarding the tracking and reporting of information for the workplace, such as job bench marking, implementation plans, performance and results information and the like. For example, an exemplary job tracking and reporting system may include various of the embodiments and examples described in U.S. Provisional Application No. 60/165,116, entitled "Workplace Tracking and Reporting System", filed on November 12, 1999, having common inventors and assignees, and hereby incorporated by reference herein. In accordance with this aspect, the workplace job assessment system may suitably interface, such as through an Internet Protocol (IP) and the like, to a company's job tracking and reporting system to directly access workplace information and thus facilitate a more dynamic workplace assessment system.

In accordance with another embodiment, the improved AI engine can comprise a multi-level analysis process that is capable of incrementally improving and for providing optimal solutions to cases that have not been encountered on prior occasions, or for creating new cases not yet been encountered at all. In accordance with this exemplary embodiment, with reference

to Figure 9, an improved method for solving cases 900 comprises a step of collecting the data and information 902 within a case, and then determining in step 904 whether a similar case exists in the database, for example, within a margin of error. In the event a similar case is identified in step 904, then a suitable solution can be identified and provided in step 906.

If on the other hand no similar case is found in step 904, method 900 can proceed to widen the margin of error in step 908, and thus consider a larger group of cases for matching in step 904, or directly to step 910. If however, method 900 does not decide to widen the margin of error, then the present case can be suitably broken down into multiple problems or components in step 910. This breaking down of components can be conducted under various methodologies, including, for example, rule-based engines, or by other simplistic or complex algorithms, or by other processes known or later devised. The number n of components or problems broken can comprise any number within a case.

For each problem or component within a case, method 900 can assess in step 912 whether that problem or component is similar or nearly identical to another problem or component within a problem or component database, for example, within a margin of error. If a similar problem or component is identified in step 912, a recommendation based on the similar problem or component can be identified in step 914, and method 900 can return to repeat step 912 until each problem or component has been analyzed. Once each component or problem had been analyzed, method 900 can proceed to construct a new case and solution for the new problem and recommendation set in a step 916. Accordingly, method 900 can continue to build an improved database for solving problems.

In the event that method 900 can not identify a similar problem or case in step 912, method 900 can proceed to a step 918 for further breaking down the problem or component into

further *m* elements. For each element within a problem or component, method 900 can assess in step 922 whether that element is similar or nearly identical to another element within an element database, for example, similar within a margin of error. If a similar problem or component is identified in step 912, a suggestion based on the similar element can be identified in step 924, and method 900 can return to repeat step 922 until each problem or component has been analyzed. In this example, a suggestion comprises the resolution of, or other information associated with, a given element, while a recommendation comprises a set of suggestions. Once each component or problem had been analyzed, method 900 can proceed to construct a new problem and recommendation for the new element and suggestion set in a step 920, and then return to step 912 to re-analyze the given problem. Accordingly, method 900 can continue to build an improved database for solving problems.

In addition, in the event that no similar element is identified in step 922, method 900 can proceed to step 926 for synthesizing new elements and suggestions based on a learning process. This learning process can comprise manual intervention based on expertise, or calculated guesses and/or algorithms designed to combine parts and elements of other problems into a complex whole component or problem set.

In addition, it should be noted that method 900 can further break down into the elements into sub-elements for comparison and identification of other sub-elements within a sub-element database prior to proceeding to step 926. In other words, this breaking down process can suitably continue for multiple levels as is practicable for a given case or problem set. Further, it should be noted that the comparison steps, such as steps 912 or 922, can assess less than all of the problems, components, elements or sub-elements before providing a new problem or a new case or recommendations.

As a result, the improved method 900 can facilitate a heuristic, multilevel process capable of solving various industrial, manufacturing, engineering and business problems, as well as optimizing solutions for the various problems and issues. Moreover, the database of problems and solutions created can be continually improved as more cases are analyzed. For example, as the number of cases continues to grow, the relative margin of error , if utilized, can be suitably reduced. For example, while a process 900 may include a 15% margin of error, as more cases are added to the case database, and thus the probability of finding case matches suitably increases, the margin of error can be suitably reduced, for example to 10% or less, even to the point of elimination.

Regardless of the assessment and solution methodology utilized, the solutions can be suitably communicated to the end users or requestors in various forms. For example, written reports providing the information can be suitably provided by the system. However, in accordance with another aspect of the present invention, the solutions and recommendations provided by method and system 200 can be configured in a manner that facilitates efficient access and real-time response systems to the various problems and issues of end users.

In accordance with an exemplary embodiment, the information collected in inquiry 104 can be suitably communicated through a network to a server including the knowledge base 106. With reference to Figure 10, an assessment system, such as an ergonomic risk assessment system, can include a client interface 1002 and an assessment system 1004. Users of the client interface 1002, such as company health and safety employees, insurance personnel and the like, can suitably connect through communication links, such as an Internet Protocol (IP) connection 906 and the like, to an assessment system 904, which can comprise one or more servers and processors.

The client interface 1002 is configured to facilitate the input of various information via a user interface, such as by using a common Internet browser, for example, Netscape Navigator or Microsoft Internet Explorer, through a communication link, into the IP network 1006 for receipt by assessment system 1004. Client interface can also comprise any computer or microprocessor configuration. As a result, end users can gain real-time access to new solutions and up-to-date analysis and tracking techniques without the need for distribution of software updates and modifications.

Assessment system 1004 may be located at the consultant's location, such as, for example, an ergonomic headquarters, such that the information and assessment reports and recommendations can be readily altered, updated and modified as desired. Assessment system 1004 can be configured to provide solutions as developed by methods 200, 300, and 900 and the various other exemplary embodiments as described above. Further, assessment system 904 can comprise one or more servers, as well as database storage devices.

Various other embodiments of the system may also be provided in order to implement analysis automation. For example, assessment system 1004 can include a server which can communicate via various communication links, such as an Internet, Intranet or any other like communication protocol, to a facilitator 1006, such as an ergonomic facilitator. Moreover, an additional module can be provided to the server, such as, for example, one to automate the processing of the videotape recorded at the job site. Accordingly, by digitizing the videotape and mapping a dynamic three-dimensional computer mannequin or the like to the job location, the job analysis can be completely automated.

In accordance with the exemplary embodiment for ergonomic analysis, additional modules can be developed to provide advanced analysis to be incorporated into the server as

additional features, including, for example, NIOSH Lifting Analysis Modules, Biomechanical Analysis Modules, Cost/Benefit Analysis Modules, Industrial Hygiene Modules, Work Measurement Analysis Modules, Job Safety Assessment Module, Occupational Medicine Module, Federal Regulatory Information Modules, Computer Based Training in Ergonomics, Functional Capacity Assessment Modules. These modules can be provided as optional features depending on a client's needs. These add-on modules can enable companies to perform advanced analysis and facilitate linking to industrial hygiene, industrial engineering and health and safety systems.

The present invention has been described above with reference to an exemplary embodiment. However, those skilled in the art will recognize that changes and modifications may be made to the exemplary embodiment without departing from the scope of the present invention. For example, the various processing steps dictated by the software, as well as the components for carrying out the processing steps, may be implemented in alternate ways depending upon the particular application or in consideration of any number of cost functions associated with the operation of the system, e.g., various of the steps may be deleted, modified, or combined with other steps. In addition, it should be noted that the improved AI engine is applicable to any industrial, manufacturing, engineering or business case or problem, and is not limited to use with an ergonomic system. Further, the assessment server may comprise a single server or a plurality of servers configured to function as described above. Additionally, the assessment system may include various language translators to facilitate operation within various foreign language countries. Moreover, the various communication links between servers, interfaces, modules or other system devices are not limited to Internet Protocol (IP) and may comprise any other communication protocol now known or hereinafter devised. These and other

changes or modifications are intended to be included within the scope of the present invention, as set forth in the following claims.

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CLAIMS

We claim:

1. A system for facilitating resolution of engineering and business issues, said system comprising:

an issue component for identifying the issues to be resolved;

an inquiry component for facilitating collection of client information relevant to said issue component to facilitate definition of said issue component;

a knowledge base comprising data and information for facilitating assessment of said client information; and

a solution base for compiling assessments and recommendations from said knowledge base and for reporting said assessments and said recommendations to a client; and

a network for communicating said client information to said knowledge base and for communicating said assessments and said recommendations to the client.

2. A system according to claim 1, wherein said knowledge base comprises an artificial intelligence engine for assessing said client information, said artificial intelligence engine configured for comparing an issue with an existing issue within a database to determine if similar, and thus provide a recommendation associated with said existing issue, and for breaking down said issue into smaller components for further comparison if said existing issue is not similar to said issue to thus provide a suggestion associated with said smaller components.

3. A method for reducing ergonomic injuries in the workplace, said method comprising the steps of:

identifying an ergonomic issue occurring at a client operation;

collecting information relevant to said ergonomic issue;

assessing said information collected to provide recommendations for resolving said ergonomic issue; and

providing said recommendations to a client,

wherein said step of assessing comprises using an artificial intelligence engine to provide said recommendations.

4. A method according to claim 3, said method further comprises the step of prioritizing ergonomic risks determined from said steps of collecting information and assessing said information.

5. A method according to claim 3, said step of identifying comprises the steps of

identifying and defining a plurality of tasks comprising a corresponding job;

scheduling said plurality of tasks into a time framework;

defining technical actions of any repetitive tasks within said plurality of tasks;

providing a perceived exertion value associated with said repetitive tasks; and

analyzing said technical actions by capturing movement and positioning data associated with said repetitive tasks

6. A method according to claim 3, wherein said step of assessing comprises the steps of:

developing a statement corresponding to said ergonomic issue to facilitate analysis by said artificial intelligence engine;

assessing a database of cases to identify at least one previous issue having information similar to said ergonomic issue;

providing a solution for said ergonomic issue corresponding to a previous solution to said at least one previous issue in the event that said at least one previous issue has information similar to said ergonomic issue;

redeveloping said statement to break down said statement into elements to facilitate identification of previous elements within a database being similar to said elements of said statement in the event that said at least one previous issue does not have information similar to said ergonomic issue; and

recommending solutions based on said cases having correspondence to said ergonomic issue.

7. A method according to claim 6, wherein said steps of collecting information relevant to said ergonomic issue and assessing said information collected to provide recommendations comprise communicating said information and said recommendations over a network.

8. A method for providing recommendations to engineering and business cases, said method comprising the steps of:

collecting data relating to at least one case;

determining whether a case in a database is similar to said at least one case, and providing a solution corresponding to said case if said case in said database is similar to said at least one case;

breaking down said at least one case into multiple problems if said case in said database is not similar to said at least one case; and

assessing at least one of said multiple problems to determine whether a problem in said database is similar to said at least one of said multiple problems, and providing a

recommendation corresponding to said problem if said problem in said database is similar to said at least one of said multiple problems.

9. A method according to claim 8, wherein said method further comprises assessing each of said multiple problems to determine whether at least one problem in said database is similar to said each of said multiple problems, and providing a recommendation corresponding to said at least one problem if said at least one problem in said database is similar to said at least one of said multiple problems.

10. A method according to claim 8, wherein said step of determining whether a case in said database is similar to said at least one case comprises assessing whether said case within said database is similar within a margin of error to said at least one case.

11. A method according to claim 10, wherein said margin of error is widened if said case in said database is not similar within a margin of error to said at least one case.

12. A method according to claim 10, wherein said margin of error is reduced as said method receives additional cases and provides additional solutions.

13. A method according to claim 8, wherein said step of assessing at least one of said multiple problems to determine whether said problem in said database is similar to said at least one of said multiple problems comprises assessing whether said problem in said database is similar within a margin of error to said at least one of said multiple problems.

14. A method according to claim 9, wherein said method further comprises the steps of:

breaking down said at least one of said multiple problems into multiple elements if said problem in said database is not similar to said at least one of said multiple problems; and

assessing at least one of said multiple elements to determine whether an element in said database is similar to said at least one of said multiple elements, and providing a suggestion corresponding to said element if said element in said database is similar to said at least one of said multiple elements.

15. A method according to claim 8, wherein said method further comprises the step of:

constructing a new case and solution set from said recommendation corresponding to said at least one of said multiple problems.

Docket No. 36457.0200

ABSTRACT

A method and system for facilitating resolution of engineering and business issues is provided which comprises an issue component for identifying the issues to be resolved, an inquiry component for facilitating collection of client information relevant to the issue component to facilitate definition of the issue component, a knowledge base comprising data and information for facilitating assessment of the client information; and a solution base for compiling assessments and recommendations from the knowledge base and for reporting the assessments and recommendations to a client. In addition, the system can include a network for communicating the client information to the knowledge base and for communicating the assessments and recommendations to the client. The knowledge base comprises an artificial intelligence engine for assessing the client information, wherein the artificial intelligence engine is configured for comparing the new issue with an existing issue within a database to determine if similar, and thus provide a recommendation associated with the existing issue, and for breaking down the new issue into smaller components for further comparison if the existing issue is not similar to the new issue to thus provide a suggestion associated with said smaller components. As a result, an optimal set of suggestions and recommendations can be provided for a given engineering or business issue or problem. In addition, in accordance with another aspect of the present invention, the above method can be further broken down into smaller elements and sub-elements to provide a more detailed analysis. In addition, the method and system can be suitably utilized to resolve various ergonomic engineering issues.

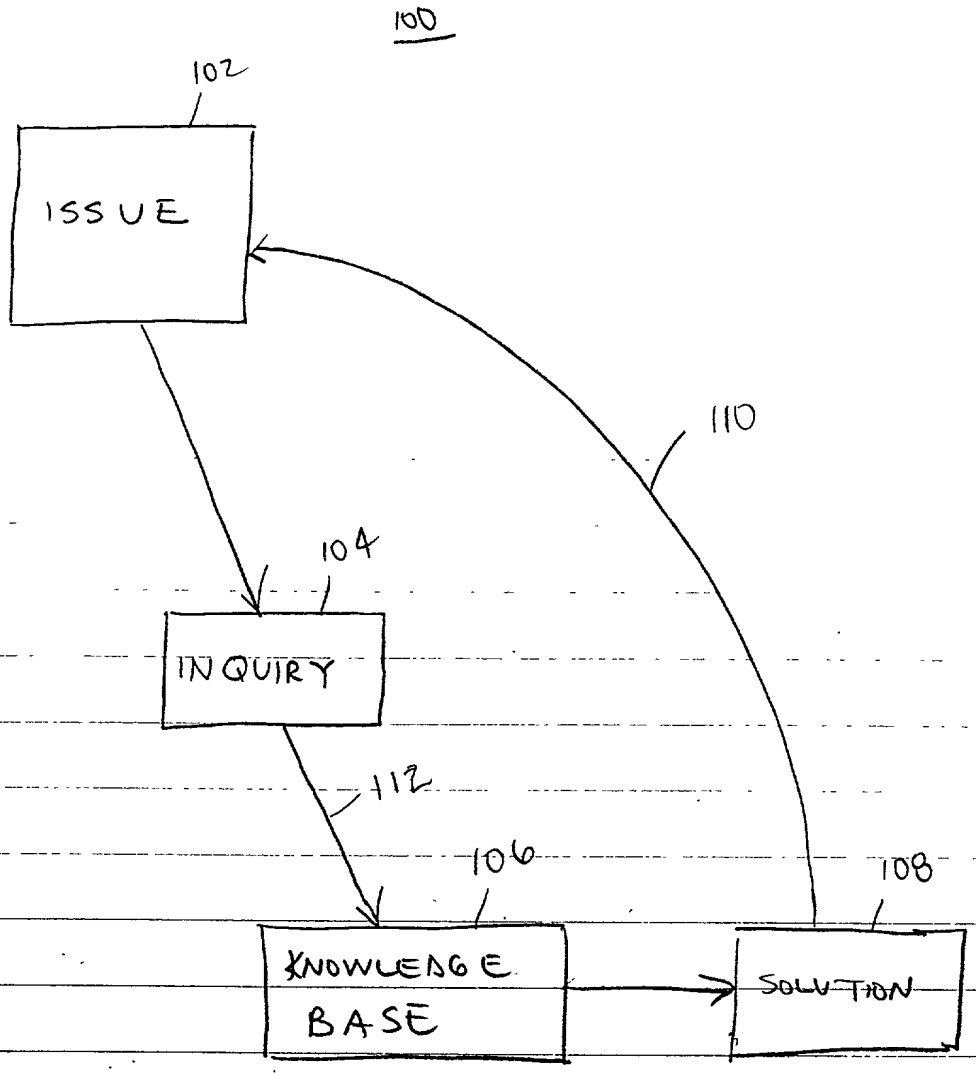
100
102
ISSUE
110
104
INQUIRY
112
106
108
KNOWLEDGE BASE
SOLUTION

FIG. 1

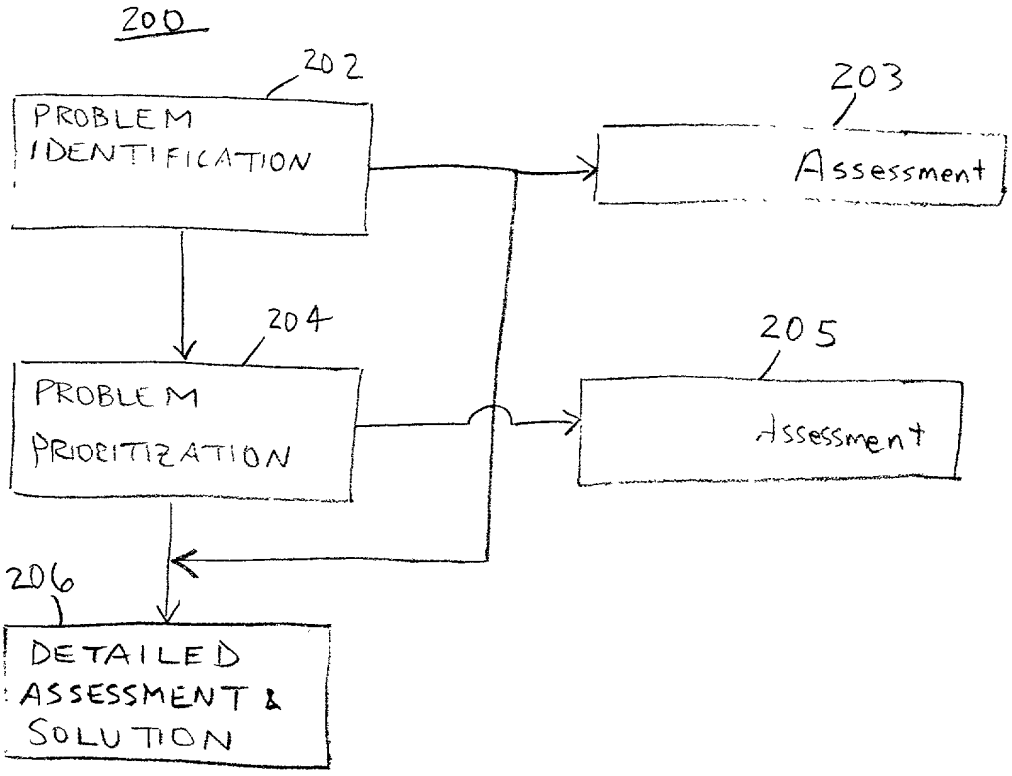
200
202
PROBLEM IDENTIFICATION
203
Assessment
204
PROBLEM PRIORITIZATION
205
Assessment
206
DETAILED ASSESSMENT & SOLUTION

FIG. 2

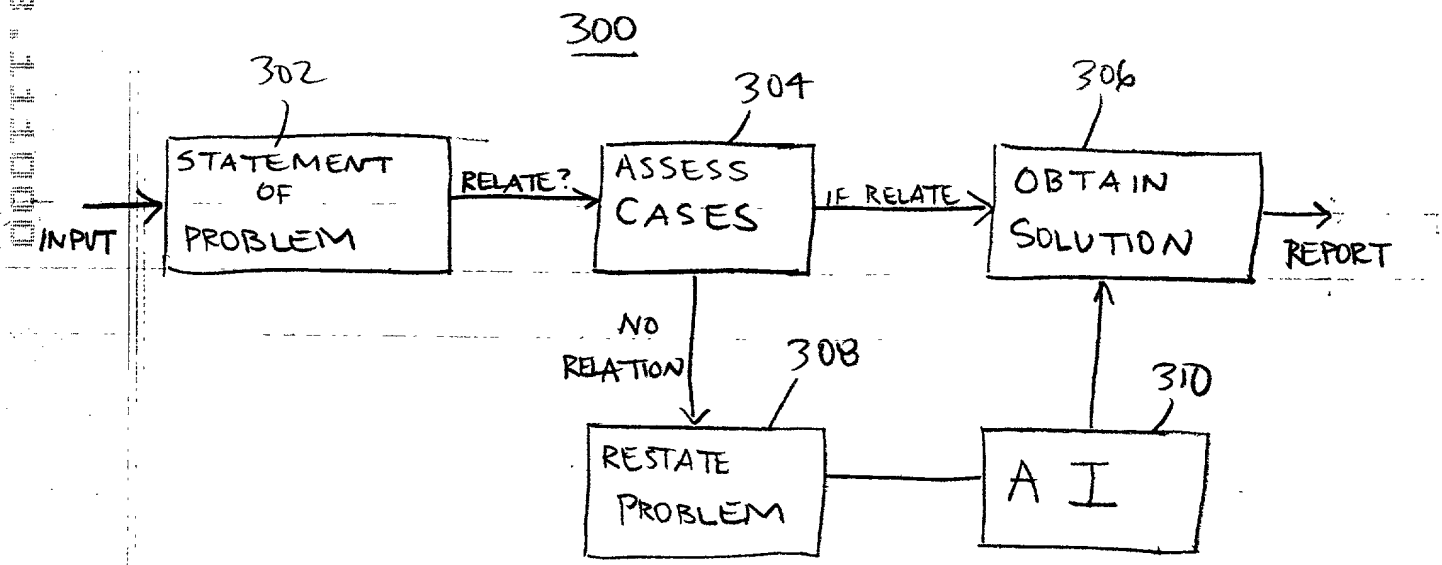
300
302
STATEMENT OF PROBLEM
INPUT
RELATE?
304
ASSESS CASES
IF RELATE
306
OBTAIN SOLUTION
REPORT
NO RELATION
308
RESTATE PROBLEM
310
AI

FIG. 3

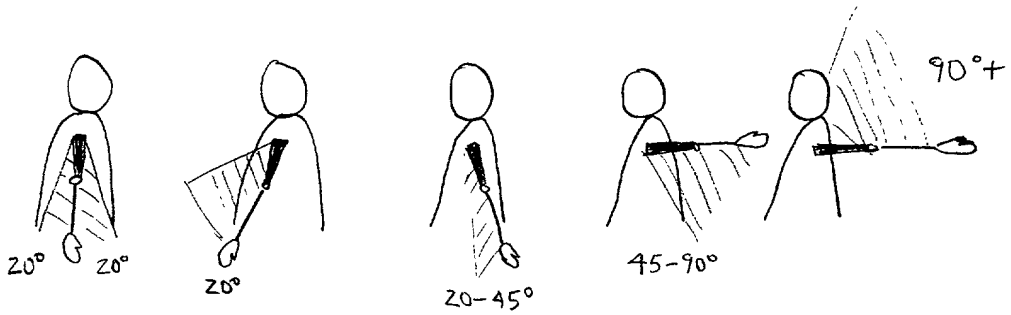

FIG. 7

TASK/ACTION	Right	Left	Remove
R-1 Cutting of large shells			
Grasp shell		1	
Place shell on lathe		5	
Remove while rotating shell		5	
Replace shell		1	
Lower lever	5		
Raise lever	5		
R-2 Cutting of small shells			
Grasp shell		1	
Place shell on lathe		9	
Remove while rotating shell		9	

FIG. 4

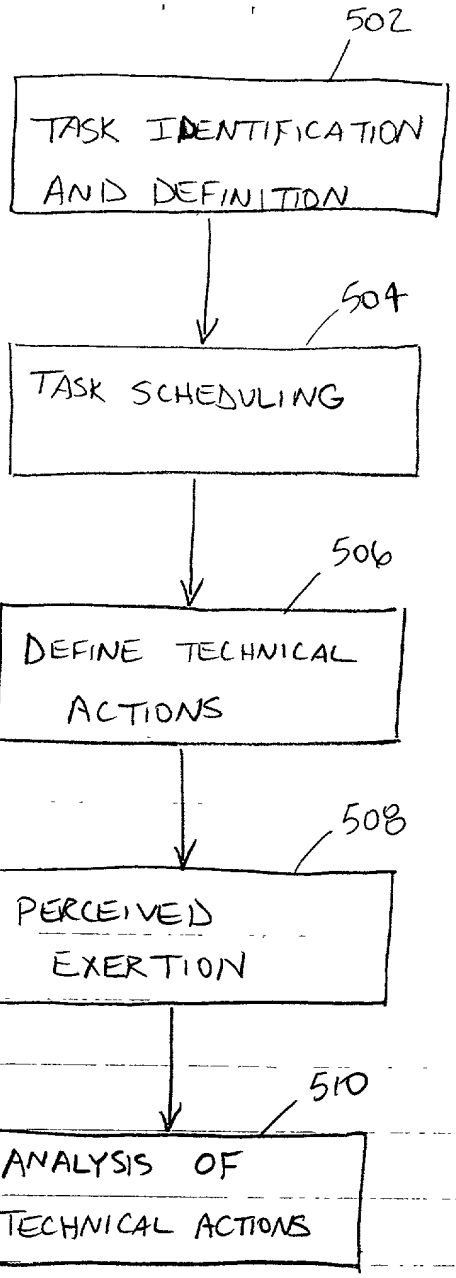
502
TASK IDENTIFICATION AND DEFINITION
504
TASK SCHEDULING
506
DEFINE TECHNICAL ACTIONS
508
PERCEIVED EXERTION
510
ANALYSIS OF TECHNICAL ACTIONS

FIG. 5

0	NOTHING AT ALL
0.5	VERY, VERY WEAK (JUST NOTICEABLE)
1	VERY WEAK
2	WEAK (LIGHT)
3	MODERATE
4	SOMEWHAT STRONG
5	STRONG HEAVY
6	
7	VERY STRONG
8	
9	
10	VERY, VERY STRONG (ALMOST MAXIMUM)

FIG. 6

Shoulder Positions and Movements - Left Side

Abduction	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Flexion	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Extension	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	

☐ Performs work gestures of the same type involving the shoulder for more than 50% of the cycle/task time?

☐ Keeps the arm raised (unsupported) by an angle more than 60 degrees or in extension for at least 10 sec. consecutively once every cycle (short cycle) . For longer cycle time increase proportionlately the time of the static contraction.

☐ Keeps the arm raised(unsupported)

at 60 degrees for > 1 minute

Shoulder Positions and Movements - Right Side

Abduction	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Flexion	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Extension	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	

☐ Performs work gestures of the same type involving the shoulder for more than 50% of the cycle/task time?

☐ Keeps the arm raised (unsupported) by an angle more than 60 degrees or in extension for at least 10 sec. consecutively once every cycle (short cycle) . For longer cycle time increase proportionlately the time of the static contraction.

☐ Keeps the arm raised(unsupported)

at 60 degrees for > 1 minute

Elbow Movements - Left Side

Supination	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Pronation	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Flexion	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	

☐ Performs work gestures of the same type involving the Elbow for more than 50% of the cycle?

Elbow Movements - Right Side

Supination	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Pronation	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	
Flexion	☒ n/a	☐ 1/3	☐ 2/3	☐ 3/3	

☐ Performs work gestures of the same type involving the Elbow for more than 50% of the cycle?

FIG. 8A

Wrist Positions and Movements - Left Side

Extension ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3
Flexion ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3
Radial Deviation ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3
Ul Nar Deviation ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3

☐ Performs work gestures of the same type involving the wrist for more than 50% of the cycle?

Wrist Positions and Movements - Right Side

Extension ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3
Flexion ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3
Radial Deviation ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3
Ul Nar Deviation ☒	n/a ☐	1/3 ☐	2/3 ☐	3/3

☐ Performs work gestures of the same type involving the wrist for more than 50% of the cycle?

Type of Grip and Finger Movements - Left Side

Tight Grip (1.5cm) ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Pinch ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Palmar Grip ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Hook Grip ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Keying Grip ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Wide Grip (4-5cm) ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3

☐ Performs work gestures of the same type involving the same finger(s) for at least 50% of the cycle?

☐ Holds an object in a pinch, palmar or hook grip for at least 50% of the cycle?

Type of Grip and Finger Movements - Right Side

Tight Grip (1.5cm) ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Pinch ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Palmar Grip ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Hook Grip ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Keying Grip ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3
Wide Grip (4-5cm) ☒	n/a ☐	1/3 ☐	2/3 ☐	2/3

☐ Performs work gestures of the same type involving the same finger(s) for at least 50% of the cycle?

☐ Holds an object in a pinch, palmar or hook grip for at least 50% of the cycle?

FIG. 8B

Case 1:16-cv-00963-CCE-JEP Document 1-3 Filed 09/29/16 Page 74 of 99

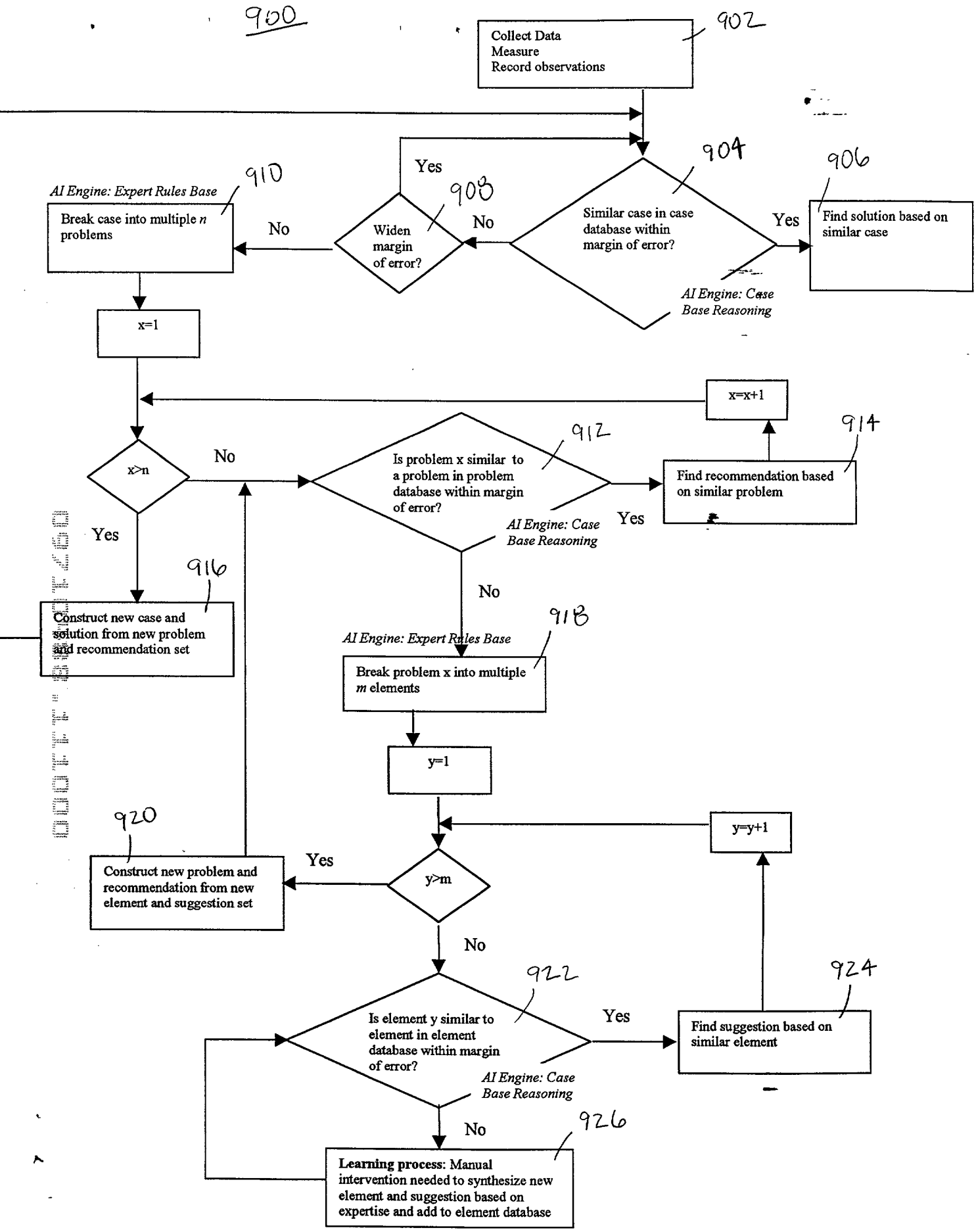
900
Collect Data
Measure
Record observations
902
Yes
904
906
AI Engine: Expert Rules Base
910
Break case into multiple n problems
No
Widen margin of error?
908
No
Similar case in case database within margin of error?
Yes
Find solution based on similar case
AI Engine: Case Base Reasoning
x=1
x=x+1
914
x>n
No
Is problem x similar to a problem in problem database within margin of error?
912
Find recommendation based on similar problem
Yes
AI Engine: Case Base Reasoning
Yes
916
Construct new case and solution from new problem and recommendation set
No
AI Engine: Expert Rules Base
918
Break problem x into multiple m elements
y=1
920
y=y+1
Construct new problem and recommendation from new element and suggestion set
Yes
y>m
No
922
924
Is element y similar to element in element database within margin of error?
Yes
Find suggestion based on similar element
AI Engine: Case Base Reasoning
No
926
Learning process: Manual intervention needed to synthesize new element and suggestion based on expertise and add to element database

FIG. 9

000TTF "88h0T260

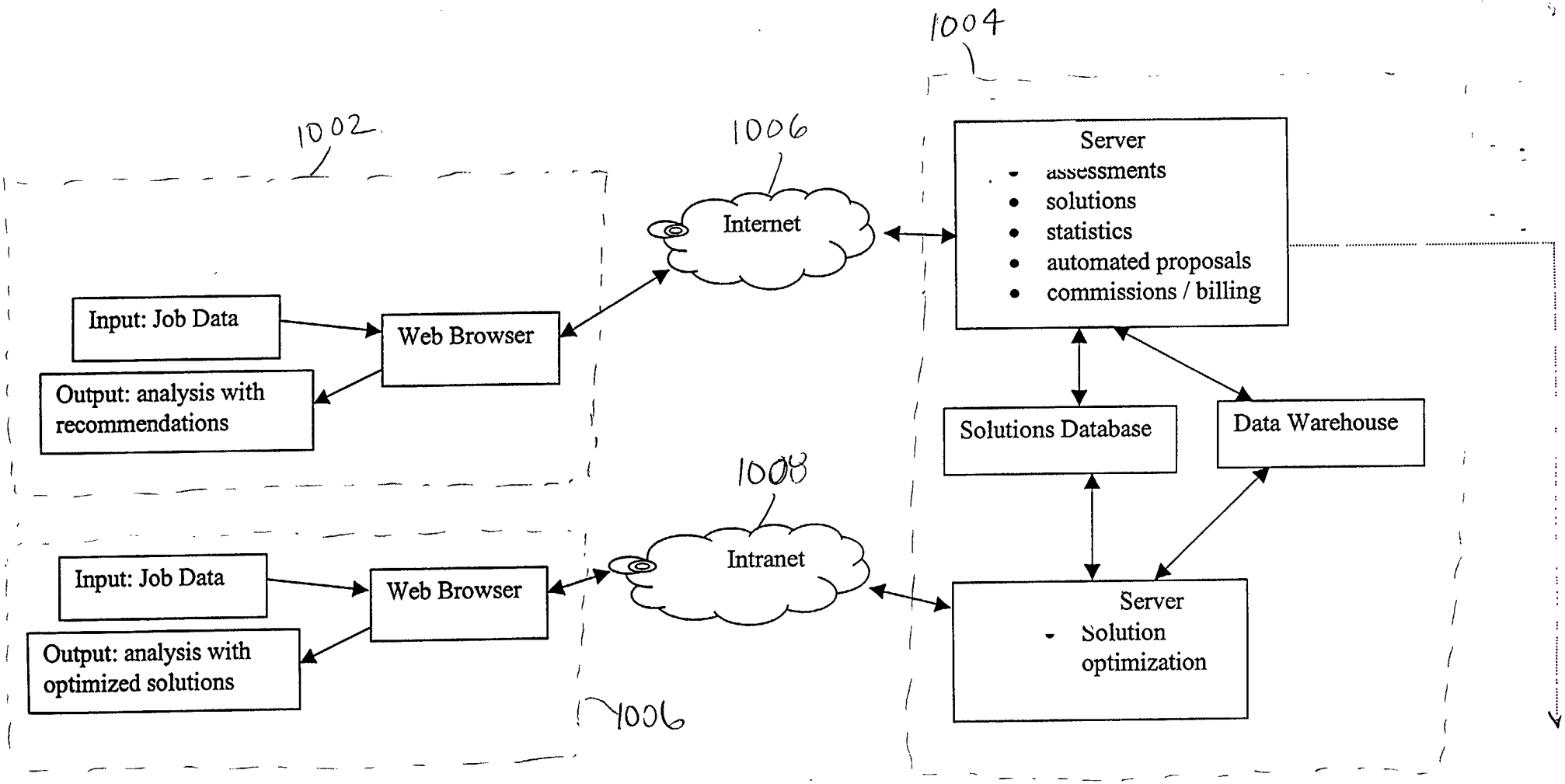

FIG 10

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Robert P. Wong, et al.	Docket No.:	36457.0200
Serial No.:	TBA	Group Art Unit:	TBA
Filed:	November 10, 2000	Examiner:	TBA
TITLE:	METHOD AND SYSTEM FOR ENGINEERING AND BUSINESS ASSESSMENT AND SOLUTIONS		

EXPRESS MAIL NO. EL426885146US

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD AND SYSTEM FOR ENGINEERING AND BUSINESS ASSESSMENT AND SOLUTIONS, the specification of which:

[X] is attached hereto.
[ ] was filed on _____ as Application Serial No._____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's

certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

			Priority Not Claimed
Number	Country	Filing Date	[ ]
Number	Country	Filing Date	[ ]

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

60/165,115	November 12, 1999
Application Number	Filing Date
Application Number	Filing Date

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 C.F.R. §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

Application Serial No.	Filing Date	Status -- Patent, Pending, Abandoned
Application Serial No.	Filing date	Status -- Patent, Pending, Abandoned
Application Serial No.	Filing Date	Status -- Patent, Pending, Abandoned
Application Serial No.	Filing date	Status -- Patent, Pending, Abandoned

Application Serial No.	Filing date	Status -- Patent, Pending, Abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Page 3 of 3

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EXPRESS MAIL NO. EL426885146US

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